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Conditional cash transfers and the double burden of malnutrition among children in Colombia: A quasi-experimental study

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Abstract

Conditional cash transfer (CCT) programmes have been shown to improve the nutritional and health status of children from poor families. However, CCT programmes may have unintended and not fully known consequences by increasing the risk of overweight and obesity. We examined the impact of *Familias en Accion* (FA), a large CCT programme in Colombia, on the double burden of malnutrition among pre-school and school age children. Height and weight were measured before programme enrolment and during follow-ups in 1,290 children from 31 treatment municipalities, being compared to 1,584 children from 62 matched control municipalities. We used a difference-in-differences approach to evaluate the effect of FA on children's stunting, body mass index (BMI) z-scores, thinness, overweight and obesity, controlling for individual and municipality-level confounders.

At baseline, the prevalence of stunting and overweight were 30.3% and 15.4% respectively in treatment municipalities and 27.9% and 17.4% in control municipalities. FA was associated with reduced odds of thinness (OR= 0.26, 95% CI 0.09, 0.75) and higher BMI z-scores (β=0.14, 95%CI 0.00, 0.27, $p < 0.05$) although the latter was of small clinical significance. The prevalence of stunting, overweight and obesity decreased over time, but FA was not significant on these outcomes. CCT programme in Colombia reduced the odds of thinness, but had no effect on stunting, a more prevalent outcome. FA programme had no effect on overweight or obesity although BMI z-scores were higher for children under treatment, raising the possibility of an increase of small significance on BMI among preschool and school age children.

Introduction

As many low- and middle-income countries, Colombia currently faces a rapid rise in the prevalence of childhood overweight and obesity, together with relatively high rates of childhood stunting in both urban and rural areas, (national average 14.9%)[1, 2]. This so-called 'double burden of malnutrition'[3] has resulted from a nutrition transition to energy dense diets high in saturated fat, sugar, and refined foods, inadequate access to healthy food choices and sedentary lifestyles[4]. Parallel to these trends, many low- and middle-income countries have introduced cash transfer programmes (conditional and unconditional), which aim to break the intergenerational transmission of poverty by providing monetary transfers to poor families [5-9]. Practically every country in Latin America, including Colombia, has a conditional cash transfer programme (CCT), while in some African and Asian nations both conditional and unconditional cash transfer programmes have also been implemented and have shown positive effects [8-14]

Several studies have shown that CCT programmes have positive effects on child health and nutritional outcomes [15-17]. CCT programmes may do so by increasing family income, raising compliance with growth and preventive care check-ups[7, 18, 19], and improving knowledge and awareness of caregiving practices through workshops[20, 21]. In Brazil, a reduction in under-five mortality has been attributed to the large CCT *Bolsa Familia* programme [22]. Likewise, CCT programmes have been linked to reductions in childhood illness in Mexico and Malawi [7, 9, 17, 23]. Evidence also suggests that CCT programmes improve the quality of diet by increasing household fruit and vegetable consumption [11, 24, 25]. Yet, some evidence suggests that cash transfers may also increase intake of unhealthy foods associated with chronic diseases[26], contributing to rising trends in body mass index (BMI). For example, a study among adults in Colombia concluded that CCT's had increased the risk of obesity among mothers[27]; likewise, evidence from Mexico's Oportunidades (now Prospera) suggests that CCT's may increase the consumption of fruits and vegetables, but also lead to excess energy consumption[28]. Concerns have thus been raised that providing cash to poor families may have unintended negative consequences on nutrition, increasing the risk of overweight and obesity [10, 29].

In 2002, the Government of Colombia introduced the CCT programme *Familias en Acción* (FA) targeting poor households with children aged 0 to 17 years [11, 27]. Currently, the FA programme serves

2.8 million households, covering a quarter of the Colombian population and over half of the nation's poor[30]. Early evidence from FA suggests that this programme was associated with a 16.5% increase on the purchase of protein-rich foods, as well as with increased height for age (0.16 Z-score) among the youngest and poorest children [11, 31, 32]. Nonetheless, less is known about the potential effects of CCT's in Colombia on the double burden of malnutrition among children of pre-school and school age, a sensitive period that may have implications for outcomes later in life[33]. In this paper, we evaluate the impact of the FA conditional cash transfer programme on under- and overnutrition of children from poor households in Colombia. We hypothesized that cash transfers would reduce rates of stunting and underweight, while also increasing the risk of overweight and obesity.

Materials and Methods

Study Population and Design

Data came from the evaluation of the FA programme up to 2006 [31]. Briefly, the FA programme is a large-scale intervention that provides cash to mothers of poor households. The programme has two components: health and education. The health component provides cash to the mothers on the condition that their children younger than 7 years regularly attend vaccination programmes, and growth and development check-ups. The educational component requires that children aged 7-17 years regularly attend school. For example, in 2002 families with children under 7 years received 40,000 Colombian pesos monthly (13% of the minimum wage) and this amount has been increased to 63,525-74,100 Colombian pesos (COP) (10-11.5% of the minimum wage) (around US$32 to US$38) for children that attend vaccination, growth and development check-ups; while families with children aged 7-17 received between 14,000 and 28,000 COP in 2002 and 10,600 to 58,225 COP currently (around US$13 to US$30) for each child that attends at least 80% of school lessons at primary and secondary level. Eligibility for the CCT programme is determined based on a scoring system known as the System for Identifying and Selecting Beneficiaries (SISBEN), a survey of low-income households used to derive a poverty score that ranges from 0-100 and enables targeting social welfare programmes [27, 34]. Implementation of the programme includes operational units at the national, departmental and municipality levels. The programme is managed and implemented by a National Coordinating Unit, but Regional Coordinating Units in each department manage the programme and liaise with the national and municipal government. Programme monitoring is a joint responsibility of departmental and municipality governments and includes a comprehensive monitoring system that follows families through the various stages of programme implementation, such as: 1) beneficiaries´ registration and status, 2) compliance with programme conditions, 3) payment of transfers, and 4) complaints and case management [34]. Municipal Liaison Offices verify that mothers meet the conditions. If a mother fails to meet the requirements three consecutive times, she could be dismissed from the programme. The money is periodically transferred to the bank account of the beneficiaries [34].

In 2001, 622 municipalities from overall 1,060 Colombia´s municipalities were selected to implement the programme because they fulfil the following criteria: 1) a population of less than 100,000 inhabitants; 2) the health and education infrastructure to guarantee programme implementation; 3) a

bank to enable cash transfers; and 4) up-to-date census, welfare and service infrastructure data. Apart from living in a municipality where the programme was implemented, families were required to: (1) hold a Colombian citizen card; (2) have children younger than 18 years; and (3) being formally classified in the lowest level of the official socio-economic classification in December 1999. At the beginning of the programme, 360,000 households fulfilled the criteria and were included in the programme [31]. To assess the impact of the programme, an evaluation was carried out by the Institute of Fiscal Studies, an independent research institute in London (United Kingdom). Details of the evaluation are available elsewhere [31]. Briefly, 57 treatment municipalities from the 622 municipalities implementing the programme were selected. These were compared to 65 matched control municipalities that were not targeted to receive the programme yet. In practice, except for the requirement to have a bank, control municipalities fulfilled all other eligibility criteria, and were thus comparable to treatment municipalities.

Baseline assessments were scheduled to take place in 2002 before the programme started, but due to political pressure, the programme started before baseline assessment in 26 out of the 57 treatment municipalities[31] and therefore were excluded from the primary analysis in this study (Figure 1).

Complete anthropometric information was available for 5,591 children aged 2 to 6 years (from a total of 6,039 of eligible participants). We excluded 746 children with missing covariates at baseline, leaving a baseline sample of 2,123 treated children and 2,722 control children. A first follow-up assessment was carried out in 2003 and included 1,814 children in the treatment and 2,283 in the control group who had previously been measured in 2002. Finally, a second follow-up assessment was carried out between 2005 and 2006, and comprised 1,290 children in treatment municipalities and 1,584 in the control group with valid data for weight and height in all the observed periods and is the final sample for this longitudinal analysis. Differences by attrition are reported in the supplementary material table S1. Overall, we found at baseline that children and their mothers lost to follow-up showed similar characteristics to the ones remaining in the follow-up. However, children lost to follow-up were slightly older (5.1 vs 4.4 years, p value <.0001), less likely to be overweight (14.1% vs 16.5%, p value 0.02) and with lower BMI z-score (0.12 z-score vs 0.22 z-score, p value 0.001). However, missing status was not significantly associated with treatment or control status.

Outcome measures

Height and weight of children were measured by trained fieldworkers using a protocol of the Pan-American Health Organization Manual on Anthropometrics [35]. Weight was measured using electronic scales (Seca 770, Vogel & Halke, Hamburg, Germany) with a precision of 0.1kg. Height was measured using measuring boards with a precision of 0.1 cm (Shorr Productions, Olney, Maryland USA). BMI was computed as weight in kilograms divided by the square of height in meters. We calculated Height-for-age Z-scores (HAZ) and BMI-for-age Z-scores (BMI z-scores), based on the World Health Organization (WHO) Child Growth Standards [36, 37]. These references are being used in Colombia since 2010 [38]. Two different outcome measures were defined: the HAZ and BMI z-score as a continuously distributed variable and a categorical variable with the following categories: stunting (HAZ < –2); thinness (BMI Z-score < –2); normal (BMI Z-score between – 1 and +1); overweight (BMI Z-score > +1) and obese (BMI Z-score > +2). In this categorization overweight includes obesity as well.

Covariates

Covariates at the individual, household and municipality levels were used as control variables. Children's individual characteristics included age, sex and whether the child was participating in *Hogares comunitarios,* a home-based childcare supplementary nutrition, and psychosocial stimulation programme for children from poor families. We controlled for maternal characteristics including mother's educational attainment, marital status, age and BMI. Mother's highest level of education completed was categorized into: 1) no education, 2) incomplete primary, 3) completed primary, 4) incomplete secondary, 5) completed secondary and 6) higher education. Covariates also included household size and household income at baseline, measured by asking respondents their income from all sources in the past month, including wages, salaries, retirement benefits, help from relatives, and rent from property. In regression models, household income was log transformed to account for non-linearities. At the municipality level, models included number of inhabitants, level of urbanization and characteristics of the geographical region categorized into: 1) Central region, 2) Caribbean region, 3) Pacific region and 4) Eastern region.

Ethical Considerations

Ethical approval for the evaluation study was granted by a local institutional ethics committee. Adults provided signed informed consent to participate in the study. Data from the evaluation are made

publically available by the Planning Department of the Colombian Government with no identifiable information on survey participants (https://www.dnp.gov.co/Paginas/inicio.aspx)

Statistical Analysis

We started by comparing characteristics of treatment and control municipalities using t (for continuous variables) or chi-squared tests (for categorical variables). Although the matched sample design tried to minimize differences between treatment and control municipalities, differences between the two groups may have persisted. These differences would bias results if variation in post-programme outcomes was due to differences in unmeasured covariates between treatment and control, rather than to the programme. Therefore, we used a difference-in-differences (DID) approach to purge estimates of programme impact from pre-existing differences. The DID compares changes between baseline and follow-up between treatment and control, instead of comparing post-treatment outcomes only. The DID estimate is thus defined as the difference in outcome in the treatment group before and after treatment minus the difference in outcome in the control group over the same period. The rationale behind this approach is that the change observed in the control group represents the counterfactual change we would have observed in the treatment group had participants not been treated [39]. This approach has been commonly applied in the evaluation of CCT programmes [40, 41].

A crucial assumption of the DID approach is that the outcome variable would have evolved in the same way between baseline and follow-up in both treatment and control municipalities had the FA programme not taken place. This is known as the common trend assumption. Although this assumption cannot be tested (we can only observe outcomes for each municipality in either treatment or control state), a common indirect test is to examine trends in the outcome prior to programme implementation. If trends in relevant outcomes were different prior to the programme, the common trend assumption would be unlikely to hold during programme implementation. We did not have data on height, weight and BMI across treatment and control municipalities before treatment. However, to assess the potential validity of the common trend assumption, we used data sources provided by the National Statistics Office (DANE: http://www.dane.gov.co/), which collects and harmonizes data on all mortality information (under-5 deaths) and birth certificates from all regions at individual-level. We estimated trends in under-5 mortality rates and birthweight in control and treatment municipalities between 1997 and 2001, before the programme started. If trends in these indicators of health and living conditions

were similar prior to the programme, this would provide an indication that the common trend assumption might hold.

We used linear regression (OLS) models to examine the impact of treatment with CCT on linear HAZ and BMI z-scores, and we implemented logistic regression models to examine the impact of the programme on stunting, thinness, overweight and obesity. The basic model was as follows:

$$y_{ijt} = \alpha + \beta_1 Time_t + \beta_2 Treatment_j + \beta_3 (Time_t * Treatment_j) + \beta_4 M_j + \beta_5 X_{ij} + e_{ijt,}$$

where y is the outcome of interest for individual i in municipality j at time t; *Time* as a dummy with value 0 for baseline assessment and 1 for assessments after the programme started; *Treatment* is a dummy with value 0 for control assignment and 1 for FA treatment assignment; M is a vector of baseline municipality-level covariates; X is a vector of baseline individual-level covariates; and e_{ij} is the error term. Coefficients for *Time* represent the change in BMI between baseline and follow-up in the control group. The treatment coefficient reflects differences in BMI between treatment and control at baseline. $Time_t$**Treatment* assesses the interaction between treatment assignment and time and corresponds to the DID estimate, as it estimates differences in height and weight trends between treatment and control. Additionally, we carried out all analyses separately for child´s sex, age, maternal education and household income.

To provide a rough estimate of the clinical significance of the effect of the *FA* programme on BMI z-scores, we estimated a Cohen´s d effect and used common conventions to determine whether effects sizes were small (0.0 to 0.20); moderate (0.20 to 0.50) or large (> 0.50) [42].

All analyses were performed using SAS software 9.3. We incorporated appropriate sample weights and calculated robust standard errors to account for differential selection probabilities and a clustered design.

Results

Table 1 shows that there were no significant differences between treatment and control groups in key baseline characteristics including children's age and sex, mother's age and BMI, household size and income, and municipality population size and geographic location. However, children in treatment municipalities were more likely to live in rural areas, less likely to participate in *Hogares Comunitarios,* a home-based childcare programme and have mothers with lower educational level. At baseline, prevalence of stunting was 30.3% for children in treatment municipalities and 27.9% for children in control municipalities. At the same time, 17.4% of children in control municipalities and 15.4% of children in treatment municipalities were overweight. The prevalence of thinness was relatively low in both treatment (1.9 %) and control (0.9 %). In addition, BMI z-scores were higher in control group (0.25) than in treatment group (0.20) and the same pattern was observed for HAZ but there were not any significant difference between the 2 groups.

Figure 2 summarizes trends in HAZ, BMI z-scores and prevalence of stunting, thinness, overweight and obesity for treatment and control municipalities among children aged 2 to 9 years. The mean HAZ increased and the prevalence of stunting decreased in both groups over time. BMI z-scores decreased in both treatment and control municipalities, but less among children from treatment municipalities. The prevalence of overweight and obesity declined in both groups, but the decline was smaller in the treatment group.

Table 2 shows estimates of the main results examining differential trends in HAZ and BMI z-scores between treatment and control, before and after programme enrolment, controlling for all covariates. Columns 1 to 2 show estimates of the effect of the programme on linear growth (HAZ and stunting). The first row indicates that in control municipalities, HAZ increased by 0.14 points (95% CI 0.10, 0.18) between baseline and follow-up assessments. The last row presents the interaction between treatment and time, the DID estimate of interest, which suggests that assignment to treatment with *Familias en Accion* was not associated with an increase in HAZ between baseline and follow-up relative to the control group. Also, there was no evidence that the FA programme influenced the odds of stunting (OR= 0.92, 95% CI 0.82, 1.05). Column 3 presents results for BMI z-scores. The FA programme was associated with a larger increase in BMI z-scores between baseline and follow-up relative to the control group (β= 0.14, 95% CI 0.00, 0.27, $p < 0.05$). Columns 4 to 6 show odds ratios

from logistic regression models examining the impact of the FA programme on thinness, overweight and obesity. While the odds of thinness doubled between baseline and follow-up in the control group (OR= 2.27, 95% CI 0.98, 5.28), children participating in the FA programme were significantly less likely to become thin after the programme (OR= 0.25, 95% CI 0.09, 0.74). In contrast, there was no evidence that the FA programme influenced the odds of overweight (OR= 1.24, 95% CI 0.80, 1.91) or obesity (OR= 0.57, 95% CI 0.21, 1.51). Supplementary analyses of the effects of the programme separately for each follow-up assessment yielded essentially the same results, although confidence intervals were somewhat wider (Supplementary table S2).

Table 3 summarizes DID estimates from models stratified by sex, age, maternal education and household income. There appeared to be a significant effect of the programme on stunting for children from mothers with more than high-school education (OR=0.68, 95%CI 0.52, 0.91). However, this was a very small group (6% of all children), while there was no evidence of an effect for the majority of children in the sample, whose mothers had less than high-school education.

Common trend assumption

A crucial assumption of the DID approach is that trends in anthropometric outcomes would have been similar in both treatment and control municipalities had the FA programme not been implemented. Although this assumption cannot be tested because we cannot observe trends in the treatment group in the absence of treatment, a common approach is to assess pre-treatment trends. Data on BMI from children in our study were not available for the pre-treatment period, but we examined pre-treatment trends in two outcomes associated with childhood undernutrition and overweight, namely under-5 mortality rates and birth weight. Figure S1 (supplementary material) shows trends in these outcomes in control and treatment municipalities between 1997 and 2001, before the programme started. Despite some fluctuations across years, there was no evidence of differential trends in infant mortality rate and urbanization between treatment and control municipalities. This was confirmed in models that suggested no interaction between municipality treatment status and time ($p > 0.05$). Although not a definitive test, this provides some reassurance that trends did not differ systematically between treatment and control. Evidence from the original evaluation also suggests that there were no pre-treatment differences in income trends between treatment and control municipalities [31].

Discussion

Our results suggest that participation in *Familias en Accion* reduced the odds of thinness, a relatively rare outcome among children in Colombia, but it had no impact on height for age z-score, stunting, overweight or obesity. FA programme participation was associated with significantly higher BMI z-scores among children. In order to provide a sense of the magnitude of this effect, we estimated Cohen´s d effect sizes (Supplementary table 4) and found that effects were small in magnitude for both. Overall, these results raise the possibility of an increase of small clinical significance on BMI among children of preschool and school age.

To our knowledge, few studies have assessed the effect of CCT programmes on children's BMI. Fernald and colleagues showed that children participating in the Mexican *Oportunidades* programme were less likely to be overweight after the treatment (β= -0.08, 95% CI -0.13, -0.03, p 0.001). However, this study only evaluated changes among children enrolled in the programme early in life, and it did not include a comparison to children in control areas [18]. Likewise, in the Peruvian *Juntos* programme BMI z-scores and the prevalence of overweight declined only among girls [43]. This may be misleading as changes most likely reflect the natural progression of BMI among children. In particular, a decline in BMI is often linked to the 'adiposity rebound' in pre-school age children, whereby BMI declines to a nadir and then begins to increase[44]. Some studies suggest that BMI should decline up to age 4, after which it starts to increase gradually[4, 44]. We also observed a decline in BMI z-scores, overweight and obesity over time, but by using a control group, we were able to show that this decline was not due to the conditional cash transfer programme, as children in treatment municipalities experienced a weaker decline in BMI than children in control municipalities.

Our results show that participation in the FA programme was associated with a reduction in the odds of thinness. Several potential explanations could account for this effect of the FA programme on thinness. First, conditional transfers may have improved the quality of home diet, thus reducing the risk of undernutrition. Early reports of FA impact suggested that families participating in the programme spent on average 15% more of their household income on food than families in the control group. Most children participating in the FA programme increased the intake of vegetables, milk and protein sources of high biological value [27]. Our findings may also be linked to better access and use of health care services, which might reduce frequency and severity of infectious diseases. This hypothesis is

substantiated by early reports of the programme suggesting that children in treatment group reported less symptoms of diarrhoea than those in the control group [32]. Project reports have also shown that families participating in the FA programme use health care services more often than families in the control group and in the general Colombian population [11, 31, 32]. The FA programme has been shown to increase compliance with the growth and development check-ups for children under 48 months, and it has increased the rates of DPT vaccination for children under 24 months [11, 31, 32].

Yet, an important consideration in interpreting these findings is the fact that the prevalence of thinness at baseline was very low in our sample (1.6%), and also the effect size estimates at group level were trivial to small (Cohen´s d effect between 0.0 to 0.20) so that the large relative effect we observed is very small in absolute terms. By contrast, the prevalence of stunting (30.3%) was very high in our sample. Previous studies across different countries have reported positive effects of CCT programmes on height in the youngest and poorest children [29, 45-47]. In our study, the FA programme had no effect on HAZ and stunting among preschool and school-aged children. This finding suggests that other factors that are not amenable to intervention through cash transfers may be more important determinants of linear growth. Stunting is often believed to be determined in the first 1000 days of live, because it is the result of multiple contributing factors early in life, including intra-uterine and antenatal influences; suboptimal breastfeeding; and frequent infection diseases into the first 24 months which can slow down growth, with little apparent catch-up growth before puberty[48].

Limitations

Our study has several strengths, including a longitudinal design with a four-year follow-up; a robust difference-in-differences approach; and the use of both direct and standardized weight and height measurements for children. However, some limitations should be considered. First, baseline response was around 80% and there was a 30% loss-to-follow-up due to the high mobility of participants. The impossibility to contact some participants partly reflects the unstable living conditions of a migrating workforce. Nevertheless, children contacted at follow-up did not differ from those who were not contacted at follow-up with respect to several key baseline individual, household and municipality characteristics and we did not find a differential loss to follow-up between the treatment and control groups.

A second limitation refers to the fact that due to political reasons, some treatment municipalities started receiving the cash transfers from the FA programme before the baseline assessment. For these municipalities, therefore, we did not have pre-treatment assessments, and we therefore excluded them from the main analysis. In sensitivity analyses, we examined the impact of the programme incorporating these municipalities as part of the treatment group (Supplementary Table S3). Although confidence intervals were wide, we found similar effects on BMI and stunting outcomes as for our original analysis. Our estimates, therefore, are unlikely to be driven by the exclusion of these municipalities from the treatment group.

Conclusion

Our results suggest that FA, a conditional cash transfer programme in Colombia, was associated with decreased odds of thinness, while there was no evidence of programme effects on stunting, overweight or obesity, the FA programme was associated with a clinically small but statistically significant increase in BMI z-scores. This raises concerns about early small negative effects on BMI among children of preschool and school age. Although these effects were small, this requires further monitoring to ensure that CCT programmes adequately address the double burden of malnutrition experienced by many low- and middle-income countries around the world.

Authors' contributions to manuscript

Design (SLA, MA), data analysis (SLA, MA), interpretation of the results (SLA, MA, AB, FJvL, IF), manuscript preparation (SLA, MA), manuscript review (SLA, MA, AB, FJvL, IF).

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Conflict of interest

The authors declare that no competing interests exist.

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Table 1 Child, maternal, household and municipality characteristics in control and treatment municipalities in *Familias en Accion (FA)*, Colombia

	Control	Treatment	*p-value*
n	1,584	1,290	
Child characteristics			
Female (n [%])	797 (50.3)	636 (49.3)	0. 96
Age, years (mean [SD])	4.5 (1.3)	4.4 (1.3)	0.51
Childcare "Hogares" participation (n [%])	897 (56.6)	521 (40.4)	0.01[a]
Anthropometric parameters			
Height for age z-score (mean [SD])	-1.42 (1.13)	-1.47 (1.21)	0.88
Stunting (n [%])	442 (27.9)	391 (30.3)	0.71
BMI for age z-score (mean [SD])	0.25 (0.9)	0.20 (1.0)	0.63
BMI ((kg/m^2)) (mean [SD])	15.8 (1.3)	15.7 (1.5)	0.22
Thinness (n %)	14 (0.9)	25 (1.9)	0.70
Overweight (n %)	276 (17.4)	199 (15.4)	0.33
Obesity (n %)	37 (2.3)	41 (3.2)	0.10
Mother's and household characteristics			
Mother's age (mean [SD])	32.2 (7.1)	32.5 (7.5)	0.40
Mother lives with partner (n [%])	1,405 (88.6)	1,129 (87.5)	0.09
Mother's Education (n [%])			
No education	219 (13.8)	216 (16.7)	0.006[a]
Incomplete Primary	730 (46.1)	596 (46.2)	
Complete Primary	307 (19.4)	264 (20.5)	
Incomplete Secondary	225 (14.2)	141 (10.9)	
Complete Secondary	87 (5.5)	66 (5.1)	
Higher	16 (1.0)	7 (0.5)	
Mother's BMI (mean [SD])	25.1 (4.7)	24.7 (4.4)	0.87
Family size (mean [SD])	6.6 (2.5)	6.8 (2.4)	0.53
Household income			
Below median (n [%])	769 (48.6)	665 (51.6)	0.61
Municipality characteristics			
Level of urbanization (Rural (n [%]))	694 (43.8)	749 (58.1)	0.002[a]
Population (< 5,000 (n [%]))	458 (28.9)	452 (35.0)	0.79
Population (5,000- 14,000 (n [%]))	679 (42.9)	418 (32.4)	
Population (> 14,000 (n [%]))	447 (28.2)	420 (32.6)	
Atlantic region (n [%])	701 (44.3)	456 (35.4)	0.56
Eastern region (n [%])	319 (20.1)	209 (16.2)	
Central region (n [%])	357 (22.5)	440 (34.1)	
Pacific region (n [%])	207 (13.1)	185 (14.3)	

Healthcare centres by level of care			
Outpatient care (n [%])	49 (49.0)	26 (47.3)	0.87
Inpatient care (n [%])	51 (51.0)	29 (52.7)	

[a] Difference between treatment and control, $P < 0.05$

p-values for continuous variables are from a t- test, while those for categorical variables are from a chi-square test.

Table 2 Difference- in- differences (DID) estimate of the effect of *Familias en Accion* (FA) conditional cash transfer programme on BMI z-scores, thinness, overweight and obesity, Colombia

	HAZ[a]	Stunting[b]	BMI z-scores[a]	Thinness[b]	Overweight[b]	Obesity[b]
	β-Coefficient (95% CI)	Odds ratio (95% CI)	β-Coefficient (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)
Treatment vs control at baseline	0.02 (-0.20, 0.25)	0.99 (0.72, 1.35)	-0.11 (-0.27, 0.05)	**5.56 (1.76, 17.5)**	0.83 (0.52, 2.03)	**2.02 (1.04, 3.95)**
Time trend in control group	**0.14 (0.10, 0.18)**	**0.75 (0.69, 0.80)**	**-0.29 (-0.38, -0.20)**	2.27 (0.98, 5.28)	**0.51 (0.37, 0.69)**	0.82 (0.40, 1.70)
DID Estimate of FA programme	0.00 (-0.10, 0.11)	0.92 (0.82, 1.05)	**0.14 (0.00, 0.27)**	**0.25 (0.09, 0.74)**	1.30 (0.83, 2.03)	0.56 (0.20, 1.53)

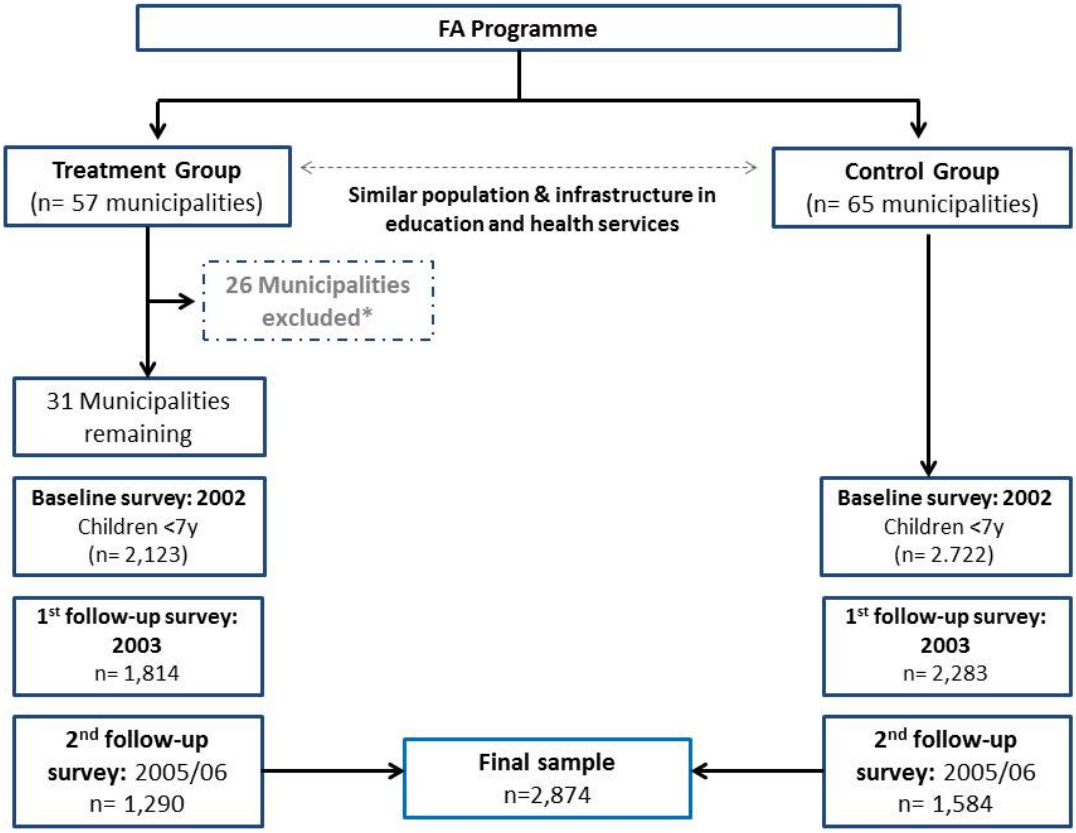
[a] Values are regression coefficients.
[b] Values are odds ratios.
Variables included in the model: age, sex, participation in *Hogares Comunitarios* (home-based health care) mother's marital status, mother's age, mother's education, mother's BMI, household income, level of urbanization, inhabitants and region.

Table 3 Sub-group analysis: Difference- in- differences (DID) estimates of the effect *Familias en Accion* (FA) conditional cash transfer programme on BMI, thinness, overweight and obesity, Colombia

	HAZ[a]		Stunting		BMI z-scores[a]		Thinness[b]		Overweight[b]		Obesity[b]	
	β-Coefficient (95% CI)	*p-value*	Odds ratio (95% CI)	*p-value*	β-Coefficient (95% CI)	*p-value*	Odds ratio (95% CI)	*p-value*	Odds ratio (95% CI)	*p-value*	Odds ratio (95% CI)	*p-value*
Child's sex												
Female	0.02 (-0.18, 0.23)		0.93 (0.77, 1.12)		0.14 (-0.01, 0.30)		0.19 (0.04, 0.81)		1.17 (0.79, 1.76)		0.87 (0.36, 2.12)	
Male	-0.01 (-0.08, 0.05)	0.66	0.93 (0.80, 1.08)	0.33	0.12 (-0.09, 0.33)	0.25	0.48 (0.13, 1.80)	0.28	1.29 (0.73, 2.29)	0.38	0.42 (0.11, 1.56)	0.20
Child's age												
2- 5 years	0.00 (-0.09, 0.10)		1.00 (0.82, 1.23)		0.12 (-0.05, 0.29)		0.21 (0.05, 0.82)		1.39 (0.86, 2.25)		0.31 (0.09, 1.06)	
≥ 5 years	-0.03 (-0.25, 0.18)	0.77	0.86 (0.60, 1.24)	0.42	0.17 (-0.02, 0.37)	0.08	0.32 (0.05, 2.02)	0.23	0.88 (0.46, 1.69)	0.98	1.83 (0.54, 6.16)	0.33
Mother's education												
Lower educated	-0.01(-0.08, 0.06)		0.96 (0.83, 1.11)		0.08 (-0.07, 0.22)		0.22 (0.07, 0.71)		1.12 (0.75, 1.67)		0.59 (0.22, 1.60)	
Secondary and higher education	0.02 (-0.11, 0.15)	0.78	**0.68 (0.52, 0.91)**	**0.01**	0.32 (-0.09, 0.72)	0.12	0.27 (0.01, 4.96)	0.38	1.53 (0.60, 3.96)	0.38	0.48 (0.11, 2.06)	0.32
Household income												
Below median	0.04 (-0.01, 0.09)		1.00 (0.86, 1.15)		0.10 (-0.05, 0.24)		0.68 (0.17, 2.65)		1.25 (0.74, 2.10)		0.49 (0.14, 1.63)	
Above median	-0.04 (-0.20, 0.11)	0.60	0.87 (0.72, 1.05)	0.14	0.17 (-0.03, 0.37)	0.09	**0.09 (0.02, 0.41)**	**<0.01**	1.22 (0.68, 2.21)	0.50	0.76 (0.27, 2.13)	0.60

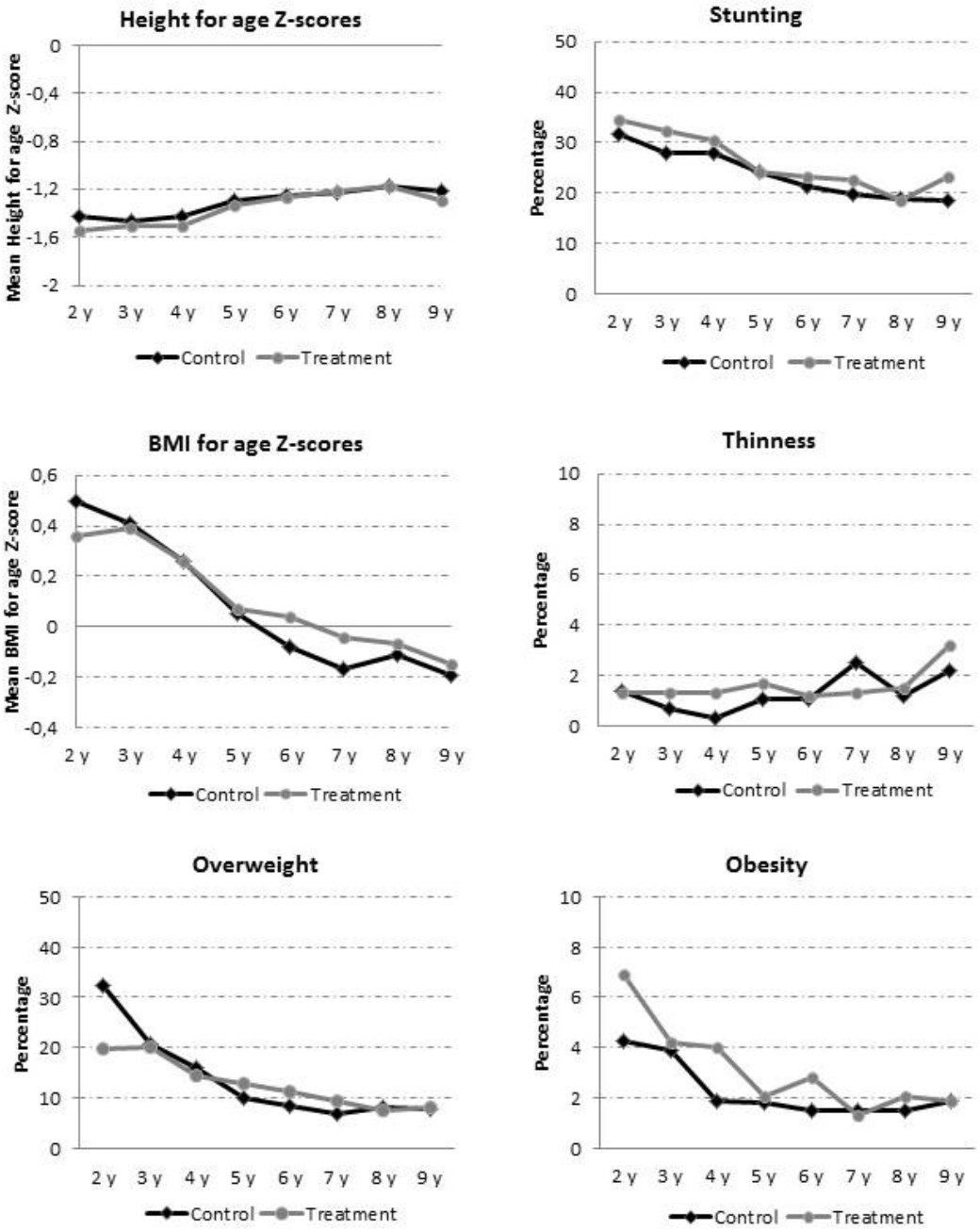
[a] Values are regression coefficients
[b] Values are odds ratios
Variables included in all models: age, sex, participation in *Hogares Comunitarios* (home-based health care) mother's marital status, mother's age, mother's education, mother's BMI, household income, level of urbanization, inhabitants and region.
Coefficients, odds ratios and p- values are for a three way interaction between treatment, time and the demographic variable of interest.

Figure 1 Participant flowchart, Familias en Accion, conditional cash trasnfer programme, Colombia



* 26 municipalities were excluded due to the programme started before baseline assessment.

Figure 2 Trends in BMI z-scores, thinness, overweight and obesity by treatment assignment, Familias en Accion, conditional cash transfer programme, Colombia



ONLINE SUPPLEMENTARY MATERIAL

Table S1 Baseline characteristics by attrition, *Familias en Accion* conditional cash transfer programme, Colombia, 2002

	Remain in the follow-up	Lost to follow-up	*p-value*
Child characteristics			
Female (n [%])	1433 (49.9)	949 (48.2)	0.22
Age, years (mean [SD])	4.4 (1.3)	5.1 (1.5)	<.0001[a]
Childcare "Hogares" participation (n [%])	1418 (49.3)	946 (48.0)	0.54
Anthropometric parameters			
Height for age z-score (mean [SD])	-1.44 (1.2)	-1.40 (1.1)	0.24
Stunting (n [%])	833 (29.0)	539 (27.4)	0.25
BMI for age z-score (mean [SD])	0.22 (1.0)	0.11 (1.1)	0.001[a]
BMI ((kg/m^2)) (mean [SD])	15.7 (1.4)	15.6 (1.5)	0.003[a]
Thinness (n %)	39 (1.4)	42 (2.1)	0.05
Overweight (n %)	475 (16.5)	277 (14.1)	0.02
Obesity (n %)	78 (2.7)	46 (2.3)	0.38
Mother's and household characteristics			
Mother's age (mean [SD])	31.8 (7.1)	31.8 (7.4)	0.85
Mother lives with partner (n [%])	2,530 (88.1)	1,623 (82.4)	<.0001[a]
Mother's Education (n [%])			
No education	435 (15.2)	324 (16.5)	0.52
Incomplete Primary	1322 (46.1)	914 (46.4)	
Complete Primary	572 (19.9)	352 (17.8)	
Incomplete Secondary	368 (12.9)	271 (13.8)	
Complete Secondary	153 (5.3)	95 (4.8)	
Higher	24 (0.8)	13 (0.7)	
Mother's BMI (mean [SD])	25.0 (4.7)	24.9 (4.3)	0.67
Family size (mean [SD])	6.7 (2.5)	6.5 (2.4)	0.53
Household income			
Below median (n [%])	1449 (50.4)	978 (49.7)	0.73
Municipality characteristics			
Level of urbanization (Rural (n [%]))	1443 (50.2)	1022 (51.9)	0.50
Population (< 5,000 (n [%]))	910 (31.7)	612 (31.1)	0.26
Population (5,000- 14,000 (n [%]))	1097 (38.2)	678 (34.4)	
Population (> 14,000 (n [%]))	867 (30.2)	679 (34.5)	
Atlantic region (n [%])	1157 (40.3)	693 (35.2)	0.03[a]
Eastern region (n [%])	528 (18.4)	491 (24.9)	
Central region (n [%])	797 (27.7)	523 (26.6)	
Pacific region (n [%])	392 (13.6)	262 (13.3)	

[a] Difference between treatment and control, $P < 0.05$

p-values for continuous variables are from a t- test, while those for categorical variables are from a chi-square test.

Table S2 Difference- in- difference (DID) estimate of the effect of *Familias en Accion* (FA) conditional cash transfer programme on BMI for each separate follow-up period, Colombia

	HAZ[a]	Stunting[b]	BMI z-scores[a]	Thinness[b]	Overweight[b]	Obesity[b]
	β-Coefficient (95% CI)	Odds ratio (95% CI)	β-Coefficient (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)
Treatment group	0.04 (-0.15,0.24)	0.99 (0.72, 1.35)	-0.10 (-0.26, 0.07)	**5.00 (1.71, 14.6)**	0.83 (0.54, 1.29)	1.89 (1.00, 3.59)
Time dummy at 1st follow-up	**0.08 (0.04, 0.11)**	0.90 (0.77, 1.04)	-0.21 (-0.29, -0.13)	1.47 (0.91, 2.39)	**0.63 (0.51, 0.80)**	0.73 (0.37, 1.43)
Time dummy at 2nd follow-up	0.23 (0.18, 0.29)	0.61 (0.54, 0.68)	-0.38 (-0.51, -0.25)	2.88 (0.99, 8.40)	**0.42 (0.27, 0.65)**	0.93 (0.41, 2.09)
DID Estimate (Treatment* time dummy at 1st follow-up)	-0.03 (-0.13, 0.08)	0.92 (0.77, 1.10)	0.11 (-0.04, 0.26)	**0.31 (0.10, 0.95)**	1.16 (0.79, 1.72)	0.68 (0.21, 2.18)
DID Estimate (Treatment* time dummy at 2nd follow-up)	0.03 (-0.07, 0.14)	0.93 (0.78, 1.12)	**0.16 (0.01, 0.32)**	**0.24 (0.07, 0.84)**	1.34 (0.77, 2.34)	0.48 (0.18, 1.31)

[a] Values are regression coefficients.
[b] Values are odds ratios
Variables included in the model: age, sex, participation in *Hogares Comunitarios* (home-based health care) mother's marital status, mother's age, mother's education, mother's BMI, household income, level of urbanization, inhabitants and region.

Table S3 Difference- in- difference (DID) estimate of the effect of *Familias en Accion* (FA) conditional cash transfer programme on HAZ, stunting, BMI, thinness, overweight and obesity for total treatment group (including municipalities that received cash transfers before baseline assessment), Colombia

	HAZ[a]	Stunting[b]	BAZ[a]	Thinness[b]	Overweight[b]	Obesity[b]
	β-Coefficient (95% CI)	Odds ratio (95% CI)	β-Coefficient (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)
Treatment group	-0.00 (-0.20, 0.20)	0.94 (0.73, 1.22)	0.01 (0.08, -0.15)	3.52 (1.16, 10.65)	0.99 (0.66, 1.49)	2.37 (1.20, 4.67)
Time dummy	**0.14 (0.10, 0.18)**	**0.75 (0.69, 0.80)**	-0.29 (-0.39, 0.20)	2.2 7 (0.98, 5.28)	**0.51 (0.39, 0.64)**	0.82 (0.40, 1.70)
DID Estimate (Treatment* time dummy)	0.03 (-0.03, 0.09)	0.89 (0.79, 1.00)	0.03 (-0.09, 0.15)	0.35 (0.12, 1.02)	1.02 (0.70, 1.50)	0.47 (0.19, 1.13)

[a] Values are regression coefficients.
[b] Values are odds ratios
Variables included in the model: age, sex, participation in *Hogares Comunitarios* (home-based health care) mother's marital status, mother's age, mother's education, mother's BMI, household income, level of urbanization, inhabitants and region.

Table S4 Cohen´s d of the effect of FA programme on Height for age z-score and BMI z-score

	Control		Treatment		Effect size (d)
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	
HAZ	-1.42 (1.1)	-1.17 (1.0)	-1.47 (1.2)	-1.20 (1.0)	0.18
BMI z-score	0.25 (0.9)	-0.12 (0.8)	0.20 (1.0)	-0.03 (0.9)	0.17

Figure S1 Test of the common trend assumption in infant mortality rate and low birthweight before treatment enrolment (1997-2001), Colombia